

XII. *A new case of Transformative Deceptive Resemblance in Long-horned Grasshoppers.* By B. P. UVAROV, F.E.S.

[Read June 7th, 1922.]

SERVILLE described (1838, p. 409) under the name of *Leptoderes ornatipennis* a leaf-like long-horned grasshopper from Java, characterised by a very peculiarly elongated pronotum. The same insect—at least, the same genus, if not species—has been redescribed and figured under the same name by Charpentier (1841, pl. 12), as well as by Brunner v. Wattenwyl (1878, p. 143, fig. 35), while Saussure described it again (1898, pp. 228–229, pl. 9, fig. 9) from Borneo and named it *Euparthenes gratiosa*, though a little later (*l. c.*, p. 806) he sank the latter name as a synonym of *Leptoderes ornatipennis* Serv., on Brunner's authority. One more species of the same genus, *L. flavipennis*, has been described by Brunner from Ceylon (1891, p. 70).

The genus *Leptoderes* (or *Leptodera*, as Brunner incorrectly called it, *Leptoderes* being the first name under which it is mentioned by Serville) has been included by Brunner in the special group, Leptoderae, of Phaneropteridae, which comprises, according to him, only one genus more, *Trochalodera* (with a single species, *T. violascens* Br. Watt., in it), the latter having been known to him by a larva only. The description and figure of *Trochalodera*, given by Brunner (1878, p. 143, fig. 36) reminds one strongly of the insect described and figured long before by Westwood (1840, pp. 419–420, pl. 28, figs. 7, 7a, 7b, 7c, 7d), under the name of *Condylodera tricondyloides*, from Java, which is also, evidently, a larva, and Dohrn (1892) did not hesitate to synonymise Brunner's species with that of Westwood, while he expressed the opinion that it was a mature insect.

Having recently received two specimens of *Condylodera*, taken one in Java and another in Borneo by Mr. G. E. Bryant who kindly gave them to me to work out, I resolved to try and find out the interrelations of all the above given genera and species. This work has been made possible only by the most obliging assistance of Prof. E. B. Poulton, who at my request brought me from the Oxford Museum the actual type of Westwood's insect together

with two more specimens, and of Prof. R. Ebner who sent me, on behalf of the Wiener Staatsmuseum, the types of the insects described by Brunner, as well as some additional specimens of the same, and my best thanks are due to them both.

The first result I have arrived at, is, that both *Condylodera* and *Trochalodera* are undoubtedly larvae, with the wings and elytra developed and placed quite normally for larvae of corresponding stages of any Tettigoniid, and the statement of Brunner (1878, p. 144), that *Trochalodera* has the elytra not covered by the hind-wings, is due simply to a misplacement of the elytra in his type, while two other specimens, also from Brunner's collection, show a normal position of elytra under the hind-wings.

At the same time, it is evident that the type of *Condylodera* is a larva of an earlier stage than *Trochalodera*, judging by the development of elytra and wings, which gives us an idea in what direction the peculiarly shaped pronotum of *Condylodera* changes during the next larval stages: this direction leads undoubtedly to the more flattened pronotum of *Leptoderes*, while all other characters, and especially the shape of the head and eyes, are in *Trochalodera* and *Leptoderes* quite identical. These considerations enable me to state, without hesitation, that *Leptoderes* is only the imago of the same insect, of which *Condylodera* and *Trochalodera* represent two different larval stages.

The material before me now enables me to describe, briefly, the whole course of transformation which this wonderful insect undergoes during its individual life.

The larva of the first stage is represented by a specimen from Brunner's collection (No. 18,498, "Tengger-Geb., Java"); its pronotum is already unusually elongated, but regularly cylindrical, slightly narrowed anteriorly; the coloration is metallic dark-blue, except the reddish legs with the tibiae brownish and the whole surface of the body, pronotum and head is perfectly smooth. In this stage the insect resembles somewhat a Cicindelid beetle of the genus *Collyris*, as has been pointed out by Shelford (1902, p. 234), but this resemblance is much more pronounced in the larva of the next stage.

The larva of the second stage is in the Oxford Museum (Java), and it is the same specimen which was put by Duponchel in his collection of Cicindelidae under the name

of *Tricondyla rufipes* Dup. (a MS. name). In this stage the pronotum is already feebly twice constricted, which makes it very like a *Collyris*; the coloration is the same as the first stage, and the surface still smooth.

Of the next (?) stage I have before me a larva taken by Mr. Bryant (Depok, Java, 18 iv. 1909; now in the British Museum) together with *Collyris tuberculata* Mel., and mistaken by him at the time of the capture for that beetle. It has the pronotum with the two constrictions very well pronounced, which gives it a really strong resemblance to *Collyris*, which is still heightened by its pronotum being distinctly punctured in the middle and in the hind portion; on the mesopleurae and the metapleurae are small lobes that represent the developing wings and elytra.

The type of Westwood's *Condylodera* is a larva of the next stage. Its pronotum undergoes further development resulting in so complete a likeness to another Cicindelid beetle, *Tricondyla cyanea* Dej., that Westwood incorporated it in his collection of Cicindelidae (*l. c.*, p. 419). This resemblance is produced by the whole surface of the pronotum being coarsely punctured throughout, while its middle swelling becomes somewhat less globose, and the hind portion slightly flattened. The rudiments of wings and elytra are already well developed and occupy a dorsal position, as may be seen in Westwood's figure, which is fairly accurate, save two lateral spots on the pronotum which cannot be seen in the type.

Three larvae from Brunner's collection (No. 7398, Java, type of *Trochalodera violascens*; Nos. 20,547 and 23,947, Malang, Java) belong unquestionably to the next (fifth?) stage. In this stage the likeness to *Tricondyla* almost disappears because the pronotum undergoes further changes: its hind portion is decidedly flattened; the two constrictions and the middle swelling included between them are very feebly expressed; there appears at the base of the hind third an obtusangulate transverse sulcus, as well as a faint suggestion of the median longitudinal line; the surface of the pronotum and of the head is strongly and densely punctured; rudiments of wings and elytra are reaching the middle of the abdomen. The coloration is also not quite like that of a *Tricondyla*, being violaceous-brown, and varying towards brown in other larvae; the coloration of the legs remains the same as it was in previous

stages. This stage is figured by both Brunner (1878, fig. 36) and Dohrn (1892, fig. on p. 65), though the latter figure is very unsatisfactory.

It is difficult to say whether the described stage is actually the last larval one, but it is very likely that it is so, judging by the dimensions of the head and the length of the pronotum.

The adult form (Charpentier, 1841, pl. 12; Brunner, 1878, fig. 35; Saussure, 1898, pl. 9, fig. 9) differs from the last described larval stage, apart from the presence of the fully developed wings and elytra which are very broad and leaf-like, by the pronotum being completely flattened on the upperside, without any constrictions or swelling, though still slightly thickened anteriorly and posteriorly, densely punctured throughout, with the angulate transverse sulcus somewhat more distinct; it is quite clear from the comparison of the last larva and adult that they represent the same insect.

This latter conclusion is still more strengthened by the study of a larva of the Ceylon species (Kandy, Ceylon; Brit. Museum) which belongs to the last stage and in which the pronotum has only very faint indication of constrictions and is practically identical in shape with that of the adult, the more so, that in this species the pronotum of the adult is not so strongly flattened as in the Javan one.

This wonderful case of one insect mimicking in different stages of its postembryonic development two other different insects (*Collyris* and *Tricondyla*) and ultimately assuming the shape and coloration of a leaf, might seem unbelievable, if there were not another definitely proved example of the same phenomenon in the case of the African Tettigoniid *Eurycorypha*, which is also leaf-like in the adult stage and an excellent ant-mimic, described under different generic name *Myrmecophana*, in the two first larval stages, while intermediate stages are also of a transitional character (Vosseler, 1908). Vosseler (*l. c.*) proposed for the latter case the term "Transformative Mimicry," and I think that it may be very conveniently adopted also for the case of *Condylodera-Trochalodera-Leptoderes*, which is still more striking than that of *Myrmecophana-Eurycorypha*; it would be, however, more correct to use the term "Deceptive Resemblance" instead of "Mimicry," which does not cover the phenomenon of leaf-resemblance of the adult.

This case gives also an exceptionally strong support to the whole theory of deceptive resemblance based on natural selection. In fact, it is not the likeness itself between *Condylodera* and *Tricondyla* which is most striking, because it might be regarded as accidental, but the fact that a metallic coloration of larvae is unknown amongst Tettigoniidae and is quite exceptional. Moreover, I have before me a larva of evidently another species of *Leptoderes* taken by Mr. G. E. Bryant at Quop, W. Sarawak, Borneo, together with *Tricondyla cyanipes* Esch. subsp. *cavifrons* Sch., which is black, with the prothorax red, and the larva of *Leptoderes* has exactly the same coloration.

Further, the larva of the Ceylon *L. flavipennis* (though in the last stage, which is not a good mimic of *Tricondyla*) differs from the Javan larvae, as has been pointed out above, by the almost not constricted pronotum, and by the brownish-black, slightly metallic shining, coloration, and these characters give it an appearance of the common Ceylon Cicindelid—*Tricondyla granulifera* Motsch., which has the same coloration and the pronotum not swollen in the middle. It is hardly possible, even for an unbeliever in mimicry, to explain these three cases by a mere coincidence!

As regards the classification and synonymy of species of *Leptoderes*, the material at my disposal is too scanty to permit of sufficiently definite conclusions. All I can say is that the Ceylon species, *L. flavipennis* Br. Watt., is distinct from the adult specimens from Borneo and Java, but I hesitate to identify all the latter as the same insect, especially as there are only two females from Borneo and two males from Java, which makes the comparison impossible. The described differences in larvae, however, indicate that there are two distinct species of *Leptoderes* in Java and in Borneo, which does not exclude the possibility that they are not confined each to one island only, as I have before me a larva from Borneo (Kuching, 12 xii. 1899, R. Shelford; Oxford Museum) in which the type of coloration is not the same as in the above described Bornean larva, but the same as in the Javanese one, with the only difference that its entire body is black and only the pronotum shows a faint bluish colour; it may be either a colour variety of the *L. tricondylodes*, or a distinct species, which it seems to me more likely to be.

The purpose of this paper is nothing more than to draw
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once more the attention of entomologists collecting in Indo-Malaya, and especially those residing there, to this quite extraordinary case, in the hope that some of them will be able to study the whole problem more closely and to collect more extensive information than that presented above.

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